The Physics of Interstellar Travel

What is the physics behind getting a spacecraft to the nearest stars? What science can it do when it gets there? How can it send back data over enormous distances? Drawing on established physics, Coryn Bailer-Jones explores the various challenges of getting an uncrewed spacecraft to a nearby star within a human lifetime. In addition to propulsion methods such as nuclear rockets and laser sails, this book examines critical issues such as navigation, communication, and the interstellar medium. Starting from fundamental concepts, readers will learn how a broad spectrum of physics – ranging from relativity to optics, and thermodynamics to astronomy – can be applied to address this demanding problem. Assuming some familiarity with basic physics, this volume is a comprehensive and self-contained introduction to interstellar travel, and an indispensable guide for studying the literature on deep space exploration. This title is also available as open access on Cambridge Core.

Coryn Bailer-Jones is a staff member at the Max Planck Institute for Astronomy in Heidelberg where he does research on stellar and Galactic astrophysics. He teaches physics at Heidelberg University and in 2017 published the textbook *Practical Bayesian Inference*. For many years he played a leading role in the European Space Agency's space astrometry mission, Gaia.

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"*The Physics of Interstellar Travel* delivers an impressively rigorous and clear exposition of the scientific and engineering challenges and remarkable promise of future interstellar missions. I found this work to bridge theoretical depth with practical vision, making it indispensable reading for aerospace professionals and science enthusiasts alike. With thorough analysis, technical clarity, and inspiring scope, Bailer-Jones sets a new benchmark for scientific literature on interstellar exploration."

Les Johnson, Chief Technology Officer, NASA MSFC (retired), author of *A Traveler's Guide to the Stars*

"This is a comprehensive extension of current textbooks in astronautics into the realm of missions once thought to be impossible. The book's mathematical rigour should clarify for rising students the realization that steps we take today can result in practical outcomes, with the goal of reaching another star conceivable by the end of this century. Where science and engineering have not yet taken us, this textbook illustrates the direction of steps forward, aiding the community in the construction of the needed roadmap."

Paul Gilster, author of *Centauri Dreams*

"This book beams you up – literally! In this engaging and rigorous textbook, Coryn Bailer-Jones lays out the physics foundations behind interstellar travel. From nuclear rockets to laser sails, from the hazards of the interstellar medium to the challenge of beaming data home across light years, this book shows how physics can be applied to one of humanity's boldest ambitions. Clear, comprehensive, and thought-provoking, *The Physics of Interstellar Travel* is essential reading for students, researchers, and anyone curious about how to reach the stars."

Professor Andreas Hein, Université du Luxembourg

"An authoritative and pedagogical guide for anyone captivated by the prospect of deep-space exploration, *The Physics of Interstellar Travel* is grounded in existing proven physics while providing the insight to envision spacecraft reaching the nearest stars within a human lifetime."

Professor Sara Seager, Massachusetts Institute of Technology, author of *Exoplanet Atmospheres*

"Coryn Bailer-Jones' book is aimed primarily at "undergraduate science students who have completed courses in basic physics", although it certainly merits a much wider audience. Based on his BSc and MSc course delivered at Heidelberg University over several years, it is authoritative, beautifully written, and a compulsive read. The book's broad scope serves as a valuable guide to the field's diverse literature, with applications extending beyond that of interstellar travel alone. It is, above all, highly stimulating. This book will surely help to focus serious interest in long-term plans for one of the important next steps in our exploration of the universe."

Professor Michael Perryman, ESA (retired) and University College Dublin, author of *The Exoplanet Handbook*

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CORYN A. L. BAILER-JONES
Max Planck Institute for Astronomy, Heidelberg

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